

final report

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Research to improve the processing efficiency of skin on goat meat

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FINAL REPORT

MLA PROJECT PSHIP.051B

RESEARCH TO IMPROVE THE PROCESSING EFFICIENCY OF SKIN-ON GOAT MEAT

SUBMITTED BY

NORVIC FOOD PROCESSING PTY LTD & DNRE VICTORIA

25th August 2001

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MEAT AND LIVESTOCK AUSTRALIA

SUMMARY REPORT

- 1 Project No. PSHIP.051B Project Title Research to improve the processing efficiency of skin-on goat meat
- 2 Project Participants Norvic Food Processing Pty Ltd & Dept Natural Resources & Environment Victoria

3 Executive Summary

The project successfully identified an integrated system that could efficiently process skin-on goats whilst ensuring that the skin on goat meat complies with food safety requirements of importing countries. The collective results obtained from the "on site" benchmarking studies at Norvic, "off site" pig processing plant inspections and "off site" wet trials resulted in the development of the design and performance specifications of a customised scald and dehairing system for processing skin on goats. However, the project was not able to achieve the final milestone of installation of a commissioned plant at Norvic. Results from the wet trials clearly indicated that major modifications were required to commercial pig scald and dehairing units currently available before they could satisfactorily process goats. Under such circumstances Norvic's preferred option was to collaborate with one of the commercial manufacturer's to jointly develop a customised scald/dehairing unit for goats. Utilising the combined expertise of both Norvic and the collaborating commercial companies engineering staff would more likely achieve the performance targets sought. A collaborative approach would also minimise the commercial risk associated with developing such specialised equipment for both companies. It is estimated that for the performance targets sought by Norvic to be achieved namely:

- A reduction in 13 labour units @ \$45,000 pa
- the same carcass throughput level of 800 goats per shift and
- carcass quality standards of >95% dehairing with < 5% rib damage
- It would take a minimum of 52 working weeks to recoup the cost of \$0.5M quoted for the supply and installation of a new commercially manufactured scald and dehairing equipment. This assumes the manufacturer agrees to modify and commission the plant to process goats within above the quoted price.

Norvic made formal approaches to two commercial manufacturers. Both requests were declined. Since then a third company has indicated an interest in collaborating with Norvic. Despite this, the 10% processing productivity improvement sought was achieved with the existing Norvic system. Results from study clearly confirmed that livestock category had important commercial effects on the efficacy of skin on processing of goats. To achieve throughput efficiencies and minimise carcass damage it is recommended goats be drafted into 4 livestock categories based on age, weight and sex. Adoption of the recommendation is expected to reduce labour units on the shave table from the current requirement of 4 to 2 labour units. The incidence of rib damage is also expected to reduce to <2%.

• The results of the microbiological testing program conducted on skin on goats processed at Norvic Food Processing Pty Ltd are presented in Appendix 6. The results of Norvic's current QA microbiological testing program for "skin on" goats processed at Norvic are in compliance with the ESAM standard. However, it is

anticipated that as has already occurred with other species, some importing countries could impose a more rigorous testing regime. Norvic decided to be proactive on this issue and opted to investigate the following options:

- incorporation of a reagent(s) that does not pose a residue risk into the scald water to minimise the risk of cross carcass contamination
- adding steam pasteurisation and organic acid spray units into the production chain

Whilst not statistically conclusive the results suggest a combination of the the above options were effective in the decontamination of skin on goat carcasses that carry Salmonella.

4 Results

4.1 Project Description: Australia is the world's largest exporter of goat meat shipping to 25 overseas destinations. There is a strong preference in a number of these export markets for skin-on goat meat. Industry processing of skin-on goats is currently characterised by a high level of manual effort to de-hair goats and the resultant high labour costs, additional carcass downgrading cost arising from processing defects and concerns about the level of microbial safety of the processed product. Norvic Food Processing Pty Ltd and DNRE propose to address these processing industry issues by adapting the highly mechanised scalding, de-hairing and washing technology operating in the pig industry to processing skin-on goats. This project will address the industry need to develop an integrated system that efficiently processes skin-on goats whilst ensuring that the skin on goat meat complies with food safety requirements of importing countries.

4.2 Objectives

- To develop an integrated system that efficiently processes skin-on goats
- To ensure goats processed through the integrated system comply with the food safety requirements of importing countries.

Objective 1 To develop an integrated system that efficiently processes skin-on goats

The design and performance specifications of an integrated scald/de-hairing unit for processing goat's skin-on were developed after conduct of the following activities:

- Benchmarking the performance of the existing system at Norvic Food Processing Pty Ltd.
- On site visits to 3 commercial pig processing plants with modern automated scald/ dehairing systems installed achieving throughput's of up to 400 pigs per hour
- Results from wet trials collected on goats processed through a commercial pig scald and dehairing systems considered to best meet the preferred design specifications

Existing design and performance of Norvic's scald/dehair system

Norvic's existing system is a conventional pig dip lift system with a steam heated scald tank, mechanical operated basket to scoop carcasses from the tank and a single chamber dehairer. It operates on a batch basis. Five goats at a time are placed in the scald tank for 2 minutes, transferred to the dehairing chamber for a further 2 minutes after which they are tipped out onto a table for manual shaving on those parts of the carcass that have not been effectively dehaired. The goats are then re suspended back onto the processing rail for evisceration etc. Production levels achieved under this system are 90 goats per hour with a total manning level of forty-two labour units. Other issues of concern relevant to the existing system relate to the variable level of dehairing achieved on carcasses (65 to 90%), incidence of carcass defects ie broken ribs, beater marks etc and compliance to food microbiological standards. Appendix 1 summarises the production performance and manning levels of the existing system at Norvic.

Automated scald/dehairing systems

Modern pig processing facilities have largely automated the scald and dehairing process. Four types of automated pig scald and dehairing systems operating in commercial plants were inspected to identify the desirable features that could be incorporated into an improved system for goats. Appendix 2 summarises the collective views of Norvic and DNRE staff who together visited the plants. A number of features were identified for inclusion in the design specifications of a customised scald and dehairing system for goats including:

Wet trials

To evaluate the performance of a commercial pig scald and double dehairing unit to process "skin on" goats.

Norvic Food Processing Pty Ltd selected and trucked 22 goats to the co-operating pig processing plant with a Petrocelli scald/dehairing system, which was considered most suited to processing goats. The goats were slaughtered and then processed through the Petrocelli scald and dehairing system in seven different batches with variations made to the scald time, scald temperature, dehairing time and number of goats processed per batch. The results of the study are presented in Appendix 3. A digital photograph was taken of each batch of goats after processing which provided an objective record of the trial results. Key results from the trial were

- it demonstrated that goats could be processed through a double dehairing chamber.
- best individual result was 95%
- substantial savings in labour costs are achievable if the unit could be successfully commissioned for processing goats

 Norvic's investment in conducting the wet trial was beneficial as it clearly identified that major modifications are required to "off the shelf" commercial pig scald/dehairing units before they are suitable to process skin on goats to the desired quality specifications.

The collective results obtained from the "on site" benchmarking studies at Norvic, "off site" pig processing plant inspections and "off site" wet trials resulted in the development of the design and performance specifications of a customised scald and dehairing system for processing skin on goats. The design and performance specifications are summarised in Table 1

Table 1 Design and performance specifications of existing and new systems for the processing of skin on goats

Process stage	Design "current"	Performance Spec's	Design "new"	Performance Spec's
Livestock class	Minimal drafting	current	Draft & process goats into 4 categories • Class A Light goats ≤ 16kg CWT • Class B Medium goats 16.1to ≤ 20kg CWT • Class C Heavy nanny's >20kg CWT • Class D Heavy billys > 20kg CWT	Max'm throughput Class A & B 1200 per shift Class C&D 500 per shift
Stun	Manual	*LU 1	As per current	LU 1
Shackle	Manual	LU 1	As per current	LU 1
Stick and Plug, head removal	Manual	LU 1	As per current	LU 1
Weasand clip	Manual	LU 1	As per current	LU 1
De-shackle	Automatic/manual	LU 1/2	As per current	LU 0
Scald Tank	Process- batch (5 per time) Type-dip lift Scald time- 2 mins Scald temp 65C Filtration system Nil Heating method steam Refill time 10 mins Water agitation nil Wetting agent nil	LU 1	Process- revolving wheel batch system (3 class A & B goats per section/ 4 sections Scald temp 65C Filtration (coarse filter only) Heating method steam Refill time 10 mins Water agitation Yes	LU 0

			TBC	
De-hair	Process-batch (5	LU ½	Process- Double	LU 0
	per time)		de-hairer (3 class	
	Type-	Hair removal	A & B goats per	Hair removal 95-
	Rotation speed	60-70%	de-hairer	100%
	110 rpm	Osussas datasta	Rotation speed-	O
	De-nairing time	Carcass defects	Dehairing time 1	Carcass defects
	Zinins Reator type	Bloken hus 4%	Denaining unie 1	Bioken fibs 0.5%
			No of besters 66	
	No of beaters 66	70	Beater protrusion	0.070
	Beater protrusion		100 –110mm	
	100-110mm		Hair clean-up TBC	
			(open chute under	
	Hair clean-up		or conveyor belt	
	manual		under de-hairer)	
Shave Table	Manual	LU 4	Required for class	LU 1
			C & D goats for	
			hard to remove	
			places (neck,	
	Manual	1114	Manual/Auto book	
	Ivial lual		cutter	
Hang			De-hocking of 2	
			front/1hind leg is	
			recommended	
			prior to scalding to	
			facilitate tumbling	
			/reduce jamming	
			in the de-hairer	
Wash	Manual	LU 1		LU 0
Shave Rail	Manual	102		100
Onave Ran				
Singe	Manual	LU 1	Auto (S Hookev	LU 0
oilige		-	engineering	
			system)	
Polisher/	Manual	LU 1	Auto(modified	LU 0
Wash			Daylesford	
			system)	
Floor space			Additional floor	
			space required	
Microbial			E coli &coliforms	Compliance to
			Staphylococcus	USDA/FSIS
Sidius			aureus	pathogen
			Salmonellae	reduction scheme
				(Mega regs)
Throughput	800 per 8hr shift	LU 16	Range 800 to	LU 6
			1200 per 8hr shift	
	Manualati			
Irimmers	Ivianual retain	LU 3		LU 0
	0.3.			

Total	LU19	LU 6

*LU labour unit

**TBC to be confirmed

The design and performance specifications proposed above for the new integrated skin-on processing system would more than meet the performance criteria specified in the MLA partnership contract summarised below.

TARGETS	Pre-project performance	MLA targets (as per contract)	Post project performance (June01)	Norvic Long term target (June 02)
THROUGHPUT/ SHIFT	800	800	800	1200
LABOUR UNITS	19	17 (10% reduction)	17	6
QUALITY		•		

95

<5

<5

>95

<5

<5

95

<5

Nil

Table 2 Performance targets of customised goat scald/ dehair unit

Commissioning of construction of customised scald/ dehairing unit for processing skin on goats

This milestone was not achieved. Results from the wet trials clearly indicated that major modifications were required to commercial pig scald and dehairing units currently available before they could satisfactorily process goats. Under such circumstances Norvic's preferred option was to collaborate with one of the commercial manufacturer's to jointly develop a customised scald/dehairing unit for goats. Utilising the combined expertise of both Norvic and the collaborating commercial companies engineering staff would more likely achieve the performance targets sought. A collaborative approach would also minimise the commercial risk associated with developing such specialised equipment for both companies. Norvic made formal approaches to two commercial manufacturers (Appendix 4). Both requests were declined.

It is estimated that for the performance targets sought by Norvic to be achieved namely:

• A reduction in 13 labour units @ \$45,000 pa

70

4

4

ATTRIBUTES % Hair removal

% Rib damage

% Carcass damage

- the same carcass throughput level of 800 goats per shift and
- carcass quality standards of >95% dehairing with < 5% rib damage

It would take a minimum of 52 working weeks to recoup the cost of \$0.5M quoted for the supply and installation of a new commercially manufactured scald and dehairing equipment. This assumes the manufacturer agrees to modify and commission the plant to process goats within above the quoted price)

Objective 2 To ensure goats processed through the integrated system comply with the food safety requirements of importing countries

The microbiological quality of goat carcasses (skin on) processed through Norvic's current plant was assessed in relation to compliance to AQIS carcass microbiological monitoring program (ESAM). Results were collected from 2 independent sources the first from Norvic Food Processing Pty Ltd ongoing monthly quality assurance program. VIAS food microbiology staff conducted a second series of microbiological tests. The second study collected samples from 50 goats after 4 hours chilling. The 50 goats were selected to be representative of the total kill (457 head) of skin on

goats processed at Norvic on the 22nd November 2000. The samples were tested at VIAS Attwood for the following organisms

TESTS PERFORMED:

FM304 - *Eschericia coli* and Coliforms by Petrifilm FM309 - *Salmonella* spp. (Sal.)* FM310 - *Staphylococcus aureus* (Staph) FM311 - Total Plate Count 25°C (TPC 25°C)

• Brilliant Green agar was substituted for Bismuth Sulphite agar and thus FM309 deviates from AS1766.2.5-1991

RESULTS

The results of the microbiological testing program conducted on skin on goats processed at Norvic Food Processing Pty Ltd are presented in Appendix 6. The results of Norvic's current QA microbiological testing program for "skin on" goats processed at Norvic are in compliance with the ESAM standard. However, it is anticipated that as has already occurred with other species, some importing countries could impose a more rigorous testing regime. If so, then additional interventions are likely to be required to ensure ongoing compliance. One or more options for the goat processing industry to consider and facilitate compliance to more rigorous standards include:

- initiating an improved industry code of practice for the transport and lairage of goats particularly ferals. McOrist and Miller (1981) found that a pattern of extended transport periods, intensive confinement in yards and the sudden changes of environment and feeding caused severe stress in goats which resulted in them changing from being latent carriers of Salmonella to becoming active excretors
- incorporation of a reagent(s) that do not pose a residue risk into the scald water to minimise the risk of cross carcass contamination
- adding steam pasteurisation and organic acid spray units into the production chain

Norvic decided to be pro-active on this issue and opted to investigate the latter two options. Appendix 7 summarises the findings of the microbiological examination of goat carcasses undergoing varying processing treatments in experiments designed by Norvic Food Processing Pty Limited. Whilst not statistically conclusive the results suggest that the most effective treatments to decontaminate carcasses that may carry Salmonella were as follows:

- scald tank with "Hogwash", plus post dehairer burner
- scald tank with "Hogwash", plus post dehairer burner, plus 82°C water
- scald tank with "Hogwash", plus post dehairer burner, plus 2.25% acetic acid
- scald tank, plus post dehairer burner, plus 82°C spray, plus 2.25% acetic acid.

5. Financial Summary A financial summary for the project is detailed below:

Project Component	Organisation	Year	Expenditure
A PSHIP.051A	Norvic	2000/01	\$10,096.22
		2001/02	\$5,541.17
B. PSHIP.051B	DNRE	2000/01	\$15,451.00
		2001/02	\$7,329.30
C PSHIP.051C	MLA	2000/01	\$2,015.46
		2001/02	
		TOTAL (all parties)	\$40,433.15

Appendix 1 MLA Norvic Skin On Goat Trials

Date 16.02.2000

No 16022000

Two separate studies were conducted on the existing scald and dehairing system at Norvic

Study 1

Trials will be conducted commencing 16.02.2000 to measure the effect of the current goat dehairer with existing rubber beaters on a variable weight range and size of goats. J.Whelan, J.Rains, G. Findlayson, G. Erskine, and A.Hamilton conducted the trial.

Under the current system five goats at a time were being placed in the scald tank for two minutes at a water temperature of 65 deg. The goats were then placed in the dehairer for two minutes for dehairing. Production levels achieved under this system were ninety goats per hour with a manning level of forty-two.

The purpose of this trial along with measuring the effect of the current beaters and dehairer was to put two goats at a time in the system as seen on the visit to the pig plants last week. Table 1 summarises the results of the trial.

Recommendations_

Ten trials were conducted with the results from trials no 2, 5, 8 & 9 the most acceptable. The above trials were conducted over a four-day period in clean water and results could change with water quality in a production run. The results also show the need for the drafting of goats into sized lots for efficient dehairing.

J.J.Whelan

Trial	No.	Avg	Dehairer	Dehair	Hair	Carcass [Defects	Carcass	Scald	Throughput
No.	Goats	Weight	Speed (%)	Time	Removal (%)	Beater	Rib	Dehairer	Time	/Hour
								Score		
1	2	20	65	2	80	some	nil	Poor	2	60
					neck					
					b/t h legs					
2	2	20	65	4	90-95	some	nil	Fair	2	30
					neck					
					b/w h legs					
3	1	20	65	4	80	some	nil	Poor	3	15
					neck					
					b/w h legs					
4	2	10	40	2	65	nil	major	Poor	2	60
					neck, body					
					b/w legs					
5	2	10	65	4	99	nil	nil	Good	2	30
	_			_					_	
6	2	10	65	4	90	slight	one	Fair	3	30
_					~-			-		
7	1	10	65	3	85	nıl	nıl	Poor	2	20
	•	10	0.5						-	45
8	3	12	65	4	96	nıl	nıl	Good	2	45
	0	•	05	0	0.4	a li ada t		Qaad	0	<u> </u>
9	3	9	65	3	94	slight	nii	G000	2	60
10	F	7 45	C.F.	4	00			Fair	2	75
10	Э	7-15	60	4	98	one	one	Fair	Z	75
								goals		

Table 1 Benchmark results on existing Norvic scald and dehairing system

Study 2

A second study was conducted at Norvic using the existing scald and dehairing system to further study the relationship between goat livestock category, dehairing score and carcass defects, Five separate trials were conducted involving goats of varying carcass weights, age, sex and breed. Table 2 summarises the results of the study, which were also recorded digitally and presented in Figures 1 to 8

Recommendations: Results from study 2 clearly confirmed that livestock category had important commercial effects on the efficacy of skin on processing of goats. Higher dehairing scores were consistently attained for light young goats (<16kg CWT) compared to heavy old goats (nanny's & billys >20kg CWT). The incidence of broken ribs and or skin beater damage was also reduced if goats of uniform carcass weight were processed together compared to when goats of unequal size were processed

To achieve throughput efficiencies and minimise carcass damage it is recommended goats be drafted into 4 livestock categories based on age, weight and sex detailed below

Categories A& B should be given priority for skin on processing ahead of categories C & D which are more cost efficiently processed as a skin off carcass

- Class A Light goats ≤ 16kg CWT
- Class B Medium goats 16.1to ≤ 20kg CWT
- Class C Heavy nanny's >20kg CWT
- Class D Heavy billys > 20kg CWT

Adoption of this recommendation is expected to reduce labour units on the shave table from the current requirement of 4 to 2 labour units. The incidence of rib damage is also expected to reduce to <2%.

TRIAL	LIVESTOCK CATEGORY	No. per BATCH	SCALD/ DEHAIR TIMES	THROUGH PUT Per Shift	RESULTS	COMMENT
1	YOUNG GOATS CWT 10-12kg SEX female	3	Scald 2 min, 66°c Single dehairer 2 minutes per batch	600	Dehair score 98% success (Figure 1) Carcass damage minimal Rib damage Nil.	Quality high Production low throughput(50% of target)
2	YOUNG GOATS(feral) CWT 10-12kg SEX mixed (2F/2M)	4	Scald 2 mins 66°c Single dehairer 3 minutes per batch	533	Dehair score 95% billys, 98% nanny's (Figure 2) Carcass damage – beater damage to chump area (Figure 3) Rib damage Nil.	Quality: hair not removed successfully around scrotum area on billys,damage to outer surface of leg and chump of one goat Production low throughput, jamming in U-bars
3	MEDIUM GOATS (feral) CWT (18-20kg SEX male	2	Scald 3 minutes 66°c Single dehairer 3 minutes per batch	267	Dehair score 90% (Figure 4) Carcass damage minimal Rib damage Nil.	Quality hair not removed from leg / scrotum area, large clumps of hair remaining on necks, difficult to remove Production very low throughput
4	LARGE GOATS (feral) CWT 20-25kg SEX male	2	Scald 2.5 minutes 66°c Single de-hairer 4 minutes per batch	200	Dehair score 90% (Figure 5) Carcass damage minimal Rib damage Nil.	Quality Hair not removed from leg / scrotum area, large clumps of hair remaining on necks, difficult to remove Production very low throughput
5	YOUNG GOATS (boar) CWT SEX female	3	Scald 2 minutes 66°c Single dehair 2 minutes per batch	600	Dehair score 90%, 95%, 95% (Figure 6) Carcass damage some Rib damage Nil	Quality Hair- remaining on inside of legs, some beater damage to outside of legs Production Low 50% of target
6	YOUNG GOATS (feral) CWT 10-12kg SEX mixed	3	Scald 2 minutes 66 °c Single dehair 2 minutes per batch Hock removed on smaller goat	600	Dehair score 95%,(Figure 7) Carcass damage some Rib damage Nil	Quality Hair- remaining on inside of legs, some beater damage to outside of legs. Hock removal did not aid rotation Production Low 50% of target
7	YOUNG GOATS (feral) CWT 10-12kg SEX mixed	5	Scald 2 minutes 66 °c Single dehair 2 minutes per batch Dehairer speed 115%. Ubars raised (less beater protrusion)	1000	Dehair score 95%,(Figure 8) Carcass damage some Rib damage Nil	Quality Hair- remaining on inside of legs, some beater damage to outside of legs. Hock removal did not aid rotation Production 85% of target

Table 2 Effect of livestock category on throughput, dehairing score and incidence of carcass defects for skin on goats

Appendix 2- Commercial Scald/Dehairing Unit Inspections

Four abattoirs were visited by Stuart Baud, Paul Meredith, Jon Hayes, John Whelan and John Raines to inspect pig scald tanks, de-hairing systems and after burn units commercially manufactured by four different companies.

The four types of commercial systems inspected were:

- Petrocelli
- Laverton
- Stork
- Rovani

A summary of the key observations on each of the commercial systems is detailed below: Details of the Rovani system are not included as it offered no additional advantages to those observed from the other 3 systems.

1.Petrocelli System

De-shackling unit

- Automatic (worked well on variable sized pigs)
- Simple and effective

Scald tank

- 6000 litre tank (topped up with steam)
- 24 pigs in tank at one time(propelled by mechanical sweeping arms)
- Water temperature 60.8°c
- Carcases in tank for 6 minutes
- Wetting agent used in tank Hog scald
- Filtration system
- Extremely difficult to remove pigs from scald tank if chain breaks down
- High water usage

De-hairer

- Two de-hairers used, 8 rubber paddles on each, protrusion 180mm, width 20-30mm, rotation 118rpm
- Two pigs in each de-hairer
- Hair / scurf emptied through large chute under de-hairer Big labour saving
- Two operators post de-hairer
- Lacks tipping table to re-orientate pigs for re-shackling

After burn unit

- Manufactured by Simon Hookey
- Natural gas unit, uses 6000 mega-joules per hour,
- 9 burners × 4
- Usually set at 70% depending on chain speed, size of pigs and seasonal factors ie. Winter coats
- Adequate air ventilation very important
- Water cooling jacket on rail above burner
- Claimed to remove residual 20% of hair
- OH&S compliant
- No positive barriers to prevent people entering burner
- Burner showing damage from heat

Polishers

- Two horizontal pre-singe
- Four horizontal and four vertical post singe
- Wash
- Polishers run at 209rpm
- Wash and polisher manufactured by Arthur engineering, Melbourne

POSITIVES

- Throughput 200/hr
- Automatic de-shackler
- Agitator in scald tank to inhibit carcase contact
- · Wetting agent in tank to assist softening of hair
- Two de-hairers
- 80% of hair removed by de-hairers
- Two operators needed in scald/de-hairer area
- Burners remove remaining hair
- Polishers and wash remove scurf left on carcases
- The most simple of the three operations

NEGATIVES

- Large clusters of hair remaining on certain breeds (particularly if pigs are touching each other in scald tank
- Carcases do not always come out of de-hairer in position for operator (requires tipping table as per Stork)
- Smaller carcases fall through U-bars
- Large space usage

2. Laverton System

De-shackling

Automatic

Scald tank / De-hairer

- Scald tank and de-hairer one unit
- 8 pigs in unit at one time
- Rubber paddles with one stainless steel paddle on set (nylon paddles tried but considered too brittle)
- Water into scald tank circulated from outside tank, water into tank hot, steam injected to maintain heat
- Scald water not filtered (impossible to maintain spray pressure with in line filters)
- De-hairer in two sections, each section can rotate at variable speeds (exit rotation speed faster than entry rotation speed, assists in ejecting carcasses from dehairer, variable speed control on dehairer shafts to assist in maintenance ie. .inspection of paddles
- One side of U-bars angled to propel carcases through de-hairer
- Scald tank / de-hairer manufactured by Melbourne firm, approx. 12 years old (clone of an unspecified manufactured model.
- Paddle system at base of dehairer to remove hair and assist keeping water clean

After burn unit

- Gas system, 12 × 4 burners
- No polishers
- Wash

POSITIVES

- Throughput around 150-200 per hour
- De-hairer and scald tank one unit
- Only two operators needed from stunning point to post singe
- Carcases very clean when viewed in chiller
- Timing control for carcase release from de-hairing unit
- Relatively easy to clean ???
- Little risk of overcooking carcasses should there be chain breakdowns ie carcasses are not submerged in water
- Hydraulic lift off top

NEGATIVES

- Processing of pigs not observed, shift finished on arrival
- Corrosion of frame work inside unit due to mix of water and faeces (unit over 10 years old). If rebuilt owner would opt for solid stainless steel
- No filtration system for scald water
- Unit is high maintenance
- Smaller carcases fall through U-bars
- Rotation speed settings of dual dehairer shafts critical for unit to operate without clogging
- Machine will operate with doors open OH&S concern
- High water usage
- Large usage of space and capital cost

3. Stork System

De-shackling

Carcases dragged through scald tank with shackle attached, de-shackled at first de-hairer

Scald tank

- Water temperature 60.3°c
- Carcases in scald for 7 minutes
- Bars on top of tank to submerge carcases

De-hairer

- Two de-hairer units (2 door & 4 door to attain higher throughput of 400 per hour)
- Manufactured by Stork Nuhuis
- 2 rows of beaters in each unit
- 17 rubber beaters on each row in first de-hairer
- First de-hairer rotates anti clockwise, second de-hairer clockwise
- Tipping table at exit from second dehairer to re-orientate pigs to be always in the same direction & side for ease of re-shackling

After burn unit

- Air assisted
- Gas powered
- 9 × 4 burners
- Polishers pre-burner
- Wash

POSITIVES

- Relatively new plant designed for high throughput
- Two de-hairers
- Four operators from stun to re-shackle
- Opposite rotation on beaters
- Stork considered manufacturer of high quality, heavy duty durable machinery

NEGATIVES

- Extra operator needed to de-shackle small carcases when entering first de-hairer
- Large area needed to house scald tank and de-hairers
- De-shackling had to be manually manned for suckler piglets & heavy sows & boars
- Machine will operate with doors open OH&S concern
- Big capital cost

Appendix 3: Skin-on goat wet trial

OBJECTIVE

To evaluate the performance of a commercial pig scald and double dehairing unit to process "skin on" goats.

METHODOLOGY

Norvic Food Processing Pty Ltd selected and trucked 22 goats to the co-operating pig processing plant on the 26th September 2000. The goats were slaughtered and then processed through a commercial (Petrocelli) scald and dehairing system designed for pigs. The goats were processed in seven different batches with variations made to the scald time, scald temperature, dehairing time and number of goats processed per batch. Each goat processed was scored for the level of dehairing achieved, the incidence of skin beater damage and other carcass defects and plant operational problems such as carcasses jamming. A digital photograph was taken of each batch of goats after processing which provided an objective record of the trial results

RESULTS

The results are summarised in Table 1

TABLE 1 The effects of temperature and time variations in scalding and dehairing on the percentage of hair removed and incidence of carcass quality defects in skin on goats processed through a commercial (Petrocelli) pig unit

RUN	LIVESTOCK CATEGORY	No. per BATCH	SCALD/ DEHAIR TIMES	РНОТО	RESULTS	COMMENT
1	GOATS (feral) CWT approx 20kg SEX 2M	2	Scald 3min, 65°c Double dehairer 30 sec/chamber	P1944.jpg	Dehair score 75% neck/scrotum 75% neck scrotum Carcass damage 1 animal dislocated leg Skin damage minor	
2	GOATS (feral) CWT approx 20kg SEX 2M	2	Scald 3 mins 65°c Double dehairer 2 minutes/chamber	P1945.jpg	Dehair score 85% neck heavy 95% neck light Skin damage legs (heavy), point shoulder(moderate), point hips (moderate)	Skin damage from over scalding.
3	GOATS (feral) CWT approx-20kg SEX 4M	4	Scald 2 minutes <65°c?? Double dehairer 1 minute/chamber	P1946.jpg	Dehair score 65% neck/scrotum 70% neck/scrotum Skin damage legs (heavy), point shoulder(moderate), point hips (moderate)	Scald temperature too low
4	GOATS (feral) CWT approx 20kg SEX 3M	3	Scald 2minutes 61°c Double de-hairer 1 minute/chamber	P1947.jpg	Dehair score 60% scrotum/neck/side 70% side & neck 70% neck & back leg Skin damage legs (heavy), point shoulder(moderate), point hips (moderate)	Scald temperature too low
5	GOATS (feral) CWT approx 20kg SEX 3M	3	Scald 3 minutes 61°c Double de-hairer 1 minute/chamber	P1948.jpg	Dehair score 65% scrotum/side/neck (jammed against beaters) 70% neck/side 75% neck/side Carcass damage front leg damage for goat jammed, Skin damage legs (heavy), point shoulder(moderate), point hips (moderate)	Scald temperature too low U bar spacings not suited to smaller goats

6	GOATS (feral) CWT approx 25kg SEX 2M	2	Scald 2 minutes 65°c Double de-hairer 1 minute/chamber	P1949.jpg	Dehair score 80% scrotum/neck 85% neck Skin damage legs (heavy), point shoulder(moderate), point hips (moderate)
7	GOATS (feral) CWT approx 20kg SEX 2M	2	Scald 2 minutes 65°c Double de-hairer 1 minute/chamber	P1950.jpg	Dehair score 90% minor neck 60% neck/shoulder (jammed in second chamber Skin damage legs (heavy), point shoulder(moderate), point hips (moderate)
				P1951.jpg	best carcass (90%) after double polishers/wash & gas burn (10secs)
8	GOATS (feral) CWT approx 20kg SEX 2M	2	Scald 2 minutes 65°c Double de-hairer 1 minute/chamber	No photo	Dehair score 30% neck/ RH side/scrotum(jammed) 60% neck/scrotum Skin damage legs (heavy), point shoulder, point hips
9	GOATS (feral) CWT approx 20kg SEX 2M	2	Scald 2 minutes 65°c Double de-hairer 1 minute/chamber	No photo	Dehair score 60% neck/scrotum 30% neck/shoulder/scrotum (jammed /broken rib??) Skin damage legs (heavy), point shoulder, point hips)

DISCUSSION

A number of positive and negative outcomes were achieved based on the results of the trial

POSITIVES

- wet trial results demonstrated that goats could be processed through a double dehairing chamber.
- best individual result was 95%
- substantial savings in labour costs are achievable if the unit could be successfully commissioned for processing goats
- Norvic's investment in conducting the wet trial was beneficial as it clearly identified that major modifications are required to "off the shelf" commercial pig scald/dehairing units before they are suitable to process skin on goats to the desired quality specifications.

NEGATIVES

- an average dehairing score of 68.5 (range 30–95%) was achieved for the 22 goats processed & visually scored. The performance was comparable to that achieved by Norvic's existing dehairing equipment prior to it undergoing major modifications. The target dehairing performance level required from a customised unit is 95% to 100%.
- major modifications are needed to a Petrocelli unit before it can process goats to the dehairing performance and carcass quality specifications required. These include U bar spacings & shape, beater spacings, provision of hot water spray in the dehairing chambers (currently cold only) & improved temperature regulation in the scald tank.
- Petrocelli have since declined a formal request made by Norvic Food Processing Pty Ltd to work co-operatively to modify their scald/dehair unit to be able to process goats

Appendix 4 Formal letters to commercial pig scald & dehairing manufacturers seeking collaborative support

NORVIC FOOD PROCESSING PTY. LTD PO BOX 637 WODONGA 3689 VICTORIA, AUSTRALIA.

Petrocelli SRL Tecnologie Innovative Di Macellazione

S.S. Basentana, KM. 100 75012 – Bernalda – MT ITALY

Attention: Giovanni Petrocelli,

Dear Giovanni,

I would like to make a formal request to your company for their interest in adapting your scald / dehairing pig processing equipment to process skin on goats. Norvic Food Processing Pty Ltd in Australia is a major Australian meat processor processing "skin on goats" for niche export markets. We also process cattle and lamb/sheep. We are involved in a project with Meat and Livestock Australia (MLA) and the Department of Natural Resources and Environment (DNRE) to develop and implement an automated mechanised system to process skin on goats. Our target is to achieve product quality levels, manning levels and throughput's compatible to those being achieved by leading Australian pig processors. We have viewed a number of commercial scald / dehairing processing units and actually trialed one of your Petrocelli scald and double de-hairing systems operating in a large pig processing plant with limited success when compared to the existing unit we have adapted at Norvic. However the Petrocelli unit may be able to be modified to process skin on goats using the combined expertise of Petrocelli and Norvic Food Processing staff. Consequently I would like to enquire whether your company would be interested in adapting one of your existing systems to achieve the following specifications with the desired features:

Fully automated de-shackle and scald system Double de-hairing unit (No in built singe system) 95% hair removal No carcase jamming in de-hairing units (U-bars) No carcase damage (skin damage or broken ribs) If your company is interested in jointly developing a suitable system which to process goats "skin on" I would be pleased to further discuss this initiative at your earliest convenience.

Sincerely,

Jon Hayes

Managing Director

Norvic Food Processing Pty. Ltd

2nd May 2001

Attention: Volker Engelbach Export Manager Banss Innovative Meat Technologies Sclacht - und Fördertechnik GmbH Industriestraße 4, D-35216 Biedenkoph

Dear Volker,

Over the past 18 months Norvic Food Processing Pty Ltd in conjunction with Meat and Livestock Australia (MLA) and the Department of Natural Resources and Environment (DNRE) have been refining procedures for processing skin on goats through a research project. Norvic Food Processing Pty Ltd in Australia is a major Australian meat processor of cattle, lamb, mutton, deer, veal and goats for export markets. Norvic has developed particular expertise in processing "skin on" goats with an annual throughput of over 100,000 all destined for export markets requiring carcasses within a specified weight range, free of quality defects and of a high microbiological food safety standard.

Our target is to achieve the throughput, labour efficiencies, carcass quality and food safety levels being attained by leading Australian pig processors. We have viewed a wide range of commercial pig scald / dehairing processing units in operation in Australia none of which were manufactured by Banss. Whilst many of the features of these systems appear applicable to processing skin on goats our experience has indicated modifications are required. We have had limited success when we actually trialed goats through such systems when compared to the existing unit adapted and in operation at Norvic.

Norvic Food Processing Pty Ltd expects continued strong market demand for skin on goat meat. Consequently, we are still highly motivated to develop an efficient scald and dehairing unit custom built for goats. We understand Banss has a similar interest and in fact has produced a scald and dehairing unit to process goats. We considers there may be considerable synergies if the combined expertise of Banss and Norvic supported by MLA worked together to further develop a custom built unit for goats with the features detailed below:

- Fully automated de-shackle and scald system
- Throughput of 200 per hour
- Two labour units to man the scald/dehairing unit
- Double de-hairing unit (No in built singe system)
- 95% hair removal
- No carcase jamming in de-hairing units (U-bars)

- No carcase damage (skin damage or broken ribs)
- Scald design & water filtration system to optimise food safety standards

If your company were interested in jointly developing a suitable system to process goats "skin on" I would be pleased to further discuss this initiative at your earliest convenience. Sincerely,

John Hayes Managing Director Norvic Food Processing Pty. Ltd

Appendix 5: Report on initial plant microbial audit

OBJECTIVE

To assess the microbiological quality of goat carcasses (skin on) with respect to general hygiene and for the presence of pathogenic organisms for goats processed through Norvic's commissioned plant

METHODOLOGY

The microbiological quality of goat carcasses (skin on) processed through Norvic's current plant was assessed in relation to compliance to AQIS carcass microbiological monitoring program (ESAM). Results were collected from 2 independent sources the first from Norvic Food Processing Pty Ltd ongoing monthly quality assurance program. VIAS food microbiology staff conducted a second series of microbiological tests. The second study collected samples from 50 goats after 4 hours chilling. The 50 goats were selected to be representative of the total kill (457 head) of skin on goats processed at Norvic on the 22nd November 2000. The samples were tested at VIAS Attwood for the following organisms

TESTS PERFORMED:

- FM304 Eschericia coli and Coliforms by Petrifilm
- FM309 Salmonella spp. (Sal.)*
- FM310 Staphylococcus aureus (Staph)

FM311 - Total Plate Count 25°C (TPC 25°C)

• Brilliant Green agar was been substituted for Bismuth Sulphite agar and thus FM309 deviates from AS1766.2.5-1991

RESULTS

The results of the microbiological testing program conducted on skin on goats processed at Norvic Food Processing Pty Ltd are presented in Table 2.

The results of Norvic's current QA microbiological testing program for "skin on" goats processed at Norvic are in compliance with the ESAM standard. However, it is anticipated that as has already occurred with other species, some importing countries could impose a more rigorous testing regime. If so, then additional interventions are likely to be required to ensure ongoing compliance. One or more options for the goat processing industry to consider and facilitate compliance to more rigorous standards include:

- Initiating an improved industry code of practice for the transport and lairage of goats particularly ferals. McOrist and Miller (1981) found that a pattern of extended transport periods, intensive confinement in yards and the sudden changes of environment and feeding caused severe stress in goats which resulted in them changing from being latent carriers of Salmonella to becoming active excretors
- incorporating a vertical scald & dehairing unit rather than the conventional submersible tank type to minimise cross carcass contamination
- adding steam pasteurisation and organic acid spray units into the production chain

Table 2: Microbiological investigation of s	kin on goat carcasses v	with regard to ESAM
compliance		

Test	ESAM standard	ESAM compliance Partnership Project 23/11/00	ESAM compliance Norvic 31/10/00 - 03/12/00
E.coli	<0.33 cfu/cm ² = satisfactory 0.33 - 12.37 cfu/cm ² = marginal >12.37 cfu/cm ² = unacceptable 11/15 positive results acceptable	Comply (*SF= 1 test per 9 carcasses)	Comply (*SF= 1 test per 1000 carcasses)
TVC	<1000 cfu/cm ² = excellent 1000-10000 cfu/cm ² = good 10000-100000 cfu/cm ² = acceptable 100000-1000000 cfu/cm ² = marginal	Comply (*SF= 1 test per 9 carcasses)	Comply (*SF= 1 test per 1000 carcasses)
Coliform	N/A	Comply (*SF= 1 test per 9 carcasses)	Not recorded
S.aureus	N/A	Comply (*SF= 1 test per 9 carcasses)	Not recorded
Salmone Ila	12/51 positive results acceptable	Detected - see recommendations (*SF= 1 test per 9 carcasses)	Comply (*SF= 1 test per 5000 carcasses)

*SF= sampling frequency

4.4 Recommendations

- Continued investigation of commercial vertical scald & dehairing units adapted to process skin on goats
- Conduct a study on the effectiveness of hot water / organic acid pasteurisation systems to reduce microbial levels on goat carcasses.
- Initiate industry agreement and adoption of a code of practice for the transport and lairage of feral goats that promotes good animal welfare and clean livestock with regard to their microbiological status at slaughter.
- Investigate chemical additives to facilitate hair removal

Appendix 6: Report on the Decontamination Studies of Microbial Food Safety Status of Skin on Goats

This report summarises the findings of the microbiological examination of goat carcasses undergoing varying processing treatments in experiments designed by Norvic Food Processing Pty Limited. These were conducted over the period 23.11.00 - 6.7.01, previously reported in accessions:

- 00/125; where 50 skin on carcasses were processed under normal conditions, using a scald tank and burner,
- 01/058; where 15 skin on were processed through a scald tank but not burners sprayed with 3 litres 2.25 % acetic acid, 29 skin off sprayed with 5 litres 2.25% acetic acid, 6 skin off were not sprayed,
- 01/087; where 30 skin on goats were processed through a scald tank containing 'Hogwash' and burned, 10 were sprayed with 2.6 litres 2.25% acetic acid, 10 were sprayed with 82°C water,
- 01/101; where 10 skin on goats were scalded and burned, 5 were sprayed twice with 82°C and 5 were sprayed once only,
- 01/113; where 10 skin on goats were scalded and burned, sprayed with 82°C water and then 2.25% acetic acid.

Fifty skin on goats were sampled on 23.11.00 four hours after normal processing, which includes carcasses passing through a scald tank and a burner. Various Salmonellae were recovered from 23 carcasses (46%). The average \log_{10} total viable count per cm² (logTVC) from goats processed in this trial was 1.46.

A second trial (02.05.01) was conducted on fifty goat carcasses which were sampled following at least 12 hours chilling. Fifteen of the 50 carcasses were skin on and were run through a scald tank but not a burner, a deviation from the normal process and were sprayed with 3 litres of 2.25% acetic acid over the 15 carcasses. Several Salmonellae serotypes were isolated from 13 carcasses (87%). The average logTVC from these carcasses was 1.78. Twenty-nine skin off carcasses were sprayed with 5 litres of 2.25% acetic acid over the 29 carcasses, no Salmonellae were detected from these carcasses which had an average logTVC of 0.56. The remaining 6 skin off carcasses were not sprayed with acetic acid, no Salmonellae were detected from these 6 and the average logTVC was 1.02. No Salmonellae were recovered from skin off goat carcasses. The application of acetic acid to skin on carcasses which did not pass through the burner did not control Salmonellae in this trial. No control carcasses (processed through normal procedure without additional treatment) were included in this trial for comparison.

Thirty skin on carcasses were sampled on 06.06.01 at least 12 hours after chilling. All carcasses were run through a scald tank containing "Hogwash" to raise the pH of the water, and subsequently passed through a burner. Ten of the carcasses were sprayed with 2.25% acetic acid. No Salmonella were recovered from these carcasses and the average logTVC was 0.89. Ten other carcasses were sprayed with 82°C water. No Salmonella were recovered from these carcasses and the average logTVC was 0.89. Ten other carcasses and the average logTVC was 1.01. Ten other carcasses received no further treatment, and again no Salmonellae were recovered from these carcasses which gave an average logTVC of 1.70. From this trial it would appear that the addition of "Hogwash" to the scald tank has a positive effect in controlling Salmonellae compared to the carcasses processed in the first trial, though only a fifth of the sample size was tested in this trial. The upper limit of pH for growth of Salmonellae in the laboratory when all other growth parameters are optimal is 9.5. The pH of the scald water in this trial was reported between 10.5 and 10.9. No control carcasses were included in this trial.

Ten skin on carcasses were sampled after at least 12 hours chilling on 21.06.01.All carcasses were scalded and burned and sprayed with 82°C water. Five of the carcasses were then sprayed twice with hot water, Salmonellae were detected from one of these carcasses and the average logTVC was 1.78. The other 5 carcasses were sprayed with hot water only once, Salmonellae was recovered from 3 of these carcasses, the an average logTVC of 1.02 was obtained. The use of hot water did not eliminate Salmonellae from these carcasses. Normally processed carcasses were not included in this trial for comparison.

Ten skin on carcasses were processed through a scald tank and a burner, sprayed with 82°C water and washed with 2.25% acetic acid. Carcasses were sampled after at least 12 hours chilling on 06.07.01. Salmonellae were not deteced from any of the carcasses tested, and an average logTVC of 1.33 was obtained. No control carcasses were processed.

The results of these trials are tabulated below. The small sample numbers used in the trials and the absence of processing controls (that is, normal process where carcasses pass through a scald tank and a burner) for all trials, make it difficult to determine the baseline levels of *Salmonella* from the animals processed on each of the sampling days. The assumption is made are that the incidence of *Salmonella* on skin on goats is 46% as found in the initial trial. It is unclear if the animals originate from the same source for all the trials, and it is unknown how, and if, levels of *Salmonella* fluctuate in goats over the different seasons of the year (these trials span the spring/summer, autumn/winter months).

Recommendations

Given the above, it would appear that the most effective treatments are listed below:

- scald tank with "Hogwash", burner
- scald tank with "Hogwash", burner, 82°C water
- scald tank with "Hogwash", burner, 2.25% acetic acid
- scald tank, burner, 82°C spray, 2.25% acetic acid.

Treatment	Sample size	Log TVC	Salmonellae
Normal process	50	1.46	46%
Scald, 3I 2.25%	15	1.78	87%
acetic acid			
Skin off, 5I 2.25%	29	0.56	0%
acetic acid			
Skin off, scald	6	1.02	0%
'Hogwash', 2.25%	10	0.89	0%
acetic acid			
'Hogwash', 82°C	10	1.01	0%
water			
'Hogwash'	10	1.70	0%
82°C spray, twice	5	1.78	20%
82°C spray, once	5	1.02	60%
82°C spray, 2.5%	10	1.33	0%
acetic acid			

Table 1: Summary of numerous processing trials conducted on goat carcasses and examined microbiologically.

Joanne Bobbitt Food Microbiologist.